DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO.SU/Sci./M.Sc.Mathematics/57/2021

It is hereby inform to all concerned that, the syllabus prepared by the Board of Studies in Mathematics and recommended by the Dean, Faculty of Science & Technology the Hon'ble Vice-Chancellor has accepted the **Syllabus of M.A/M.Sc. Mathematics First Year (Ist & IInd semester) with Bridge Course for affiliated Colleges and University Department** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

This shall be effective from the Academic Year 2021-22 and onwards.

All concerned are requested to note the contents of this circular and bring notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO. SU/SCI/2021/4209-18
Date:- 29.11.2021

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Deputy Registrar,
Academic Section.

Copy forwarded with compliments to :-

1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
2] **Head of the Department, Department of Mathematics,**
Dr.Babasaheb Ambedkar Marathwada University, Aurangabad.
3] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

1] The Director, Board of Examinations & Evaluation,Dr.BAMU,A'bad.
2] The Section Officer,[M.Sc.Unit] Examination Branch,Dr.BAMU,A'bad.
3] The Programmer [Computer Unit-1] Examinations, Dr.BAMU,A'bad.
4] The Programmer [Computer Unit-2] Examinations, Dr.BAMU,A'bad.
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7] The Record Keeper, Dr.BAMU,A'bad.

DR. BABASAHEB AMBEDKAR MARATHWADA

UNIVERSITY, AURANGABAD

Uniform Curriculum of M.A. / M. Sc. (Mathematics) Course for University Department and Affiliated Colleges

Semester I & II
Under Choice Based Credit and Grading System
Including Research Component and Indian Constitution as service course.

W.E.F. 2021-2022

26/11/21
Dean
Faculty of Science & Technology
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad

Dr. Bhausaheb R. Sontakke
Chairman,
Board of Studies in Mathematics,
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad (M.S.)

The M. A. / M. Sc. (Mathematics) course consists of four semesters.

In Semesters I and II a student has to study four **core** courses and one **Elective** course. In Semesters III and IV he/she has to study two **core** courses, three **elective** courses including **research component** and **one service course (for one semester) from other Department.** Apart from this, the student will have to learn **the course on Indian Constitution** as decided / run by the University. The students admitted to this course from other University/institution shall have to complete bridge course of two credits.

The M. A. / M. Sc. (Mathematics) course will be of 120 credits.

Semester	No. of papers (core + elective)	No. of credits For each paper	No. of credits for project	Total no. of credits
I	4 + 1 = 5	6 (6x5=30)	---	30
II	4 + 1 = 5	6 (6x5=30)	---	30
III	2 + 3 = 5	4 (4x5=20)	2Cr. x 5proj = 10	20+10=30
IV	2 + 3 = 5	4 (4x5=20)	2Cr. x 5proj = 10	20=10=30
Total credits		**100 (Theory)**	**20 (Project)**	**120**

Unit wise distribution of the syllabus for the courses currently taught is given below.

Dean
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University, Aurangabad (M.S.)

M. A. / M. Sc. (Mathematics) YEAR – I

SEMESTER--I

(Core Courses)

MAT – 401	-	Abstract Algebra
MAT - 402	-	Real Analysis -I
MAT - 403	-	Topology -I
MAT - 404	-	Complex Analysis –I

Elective Courses **(Choose any one of the following)**

MAT - 421	-	Differential Equations -I.
MAT - 422	-	Advanced Discrete Mathematics -I.

SEMESTER –II

(Core Courses)

MAT - 411	-	Linear Algebra
MAT - 412	-	Real Analysis -II
MAT - 413	-	Topology -II
MAT - 414	-	Complex Analysis –II

Elective Courses **(Choose any one of the following)**

MAT - 431	-	Differential Equations -II
MAT - 432	-	Advanced Discrete Mathematics -II.

26/11/25
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21/8/2025
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Chairman,
Board of Studies in Mathematics,
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad (M.S.)

BRIDGE COURSE

M.A. /M.Sc. Mathematics- First Year

Unit –I. Basic Algebra

Definition of a group, Some examples of groups, Subgroups, Normal Subgroups and Quotient groups, Homomorphisms , Definition and examples of rings, Some special cases of rings.

Vector spaces: Elementary basic concepts, Linear independence and bases.

Unit –II. Analysis

Functions, Sequences, Convergence of sequences, Limit points of sequences, Convergent sequences, Cauchy sequences, Series, Necessary condition for Convergence, Comparison tests. Limits, Continuous function, functions continuous on closed interval, Uniform continuity, Derivability, Rolle's Theorem, Lagrange's Mean Value theorem, Cauchy's Mean Value theorem, Higher derivatives. Taylor's theorem

Text Book:

I.N.Herstein : Topics in Algebra, Second edition, John Willey and Sons.

Chapter 2: 2.1, 2.2, 2.4. 2.6, 2.7

Chapter 3: 3.1, 3.2.

Chapter 4: 4.1, 4.2.

S.C.Malik : Principles of Real Analysis, Revised edition, New Age International Publishers (P) Ltd.

Chapter 3: 1.1, 2. 3, 4,7,10

Chapter 4: 1, 1.2, 1.3, 3

Chapter 5: 1, 2, 3, 4

Chapter 5: 1, 5, 6,7,8,8.1.

25/11/19

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Dr. Babasaheb Ambedkar Marathwada
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M.Sc. YEAR FIRST YEAR
Semester – I

Course No: MAT – 401 **Credits: 06**

ABSTRACT ALGEBRA

Objective: To learn algebraic structures and its properties

Unit – I
Groups, Subgroups, Cyclic groups, Properties of cyclic groups, Classification of subgroups of cyclic groups.

Unit – II
Permutation groups, Definition and notations, Cycle notation, Properties of permutations.

Unit – III
Isomorphisms, Definition and examples, Cayley's theorem, Properties of isomorphisms, External direct products, Definition and examples, Properties of external direct product, the group of units modulo *n* as an external direct product.

Unit-IV
Ideals, Sum and direct sum of ideals, maximal and prime ideals, examples of maximal ideals, Nilpotent and Nil ideals.

Unit – V
Irreducible polynomials and Einstein criteria, Adjunction of roots, Algebraic extensions, algebraically closed fields.

Outcome:
The student will become familiar with various algebraic structures and their properties.

Text Books

1. **Joseph A. Gallian:** **Contemporary Abstract Algebra,** *Ninth Edition, CENGAGE,* 2020

   Scope: **Chapter 2, 3, 4, 5, 6, 8 (up to Theorem 8.3)**
2. **P.B. Bhattacharya, S.K. Jain, S.R. Nagpaul**: **Basic Abstract Algebra**, Second edition, *Cambridge University Press* (Reprint 2018)

   Scope: Chapter 10 (Articles 3, 4, 5), Chapter 15 (1, 2, 3, 4)

References:

1. I.N.Herstein: Topics In Algebra, Wiley Eastern Ltd., New Delhi 1975
2. M.Artin: Algebra, Pretice-Hall of India. 1991
3. D.S.Malik. J.N.Mordenson, and M.K.Sen: Fundamentals of Abstract Algebra. McGraw-Hill International Edition. 1997
4. S.Kumarsen:, Linear Algebra, A Geometric Approach, Prentice- Hall of India. 2000
5. Vivek Sahai and Vikas Bist: Algebra, Narosa Publishing House, 1999.

Semester – I

Course No. MAT- 402

Real Analysis- I **Credits 6**

Objective: The objective of this paper is to learn basics of mathematical analysis

Unit – I Definition and existence of Riemann-Stieltjes integral, Properties of the integral, Integration and Differentiation, The fundamental theorem of calculus, Examples.

Unit - III integration of vector valued functions. Rectifiable curve. Examples. Sequences and series of functio ns. Point wise and uniform convergence. Cauchy criterion for uniform convergence. Weierstrass M-test, uniform convergence and continuity, uniform convergence and Riemann-Stieltjes integration. Examples.

Unit - III Uniform convergence and Differential, The Stone – Weierstrass theorem, Examples. Power series, Abel's and Taylor's theorems, Uniqueness theorem for power series. Examples.

Unit - IV Functions of several variables, Linear transformations, Derivatives in an open subset of R^n, Chain rule, Examples

Unit - V Partial derivations. Interchange of the order of differentiation, The inverse function theorem, The implicit function theorem Jacobins, Derivatives of higher order, Differentiation of integrals. Examples,

Outcome: The student will be able to apply the knowledge in areas which use continuity of a function, uniform convergence, partial derivatives etc.

Text Book: Walter Rudin, Principles of Mathematical Analysis, (3rd Edition) McGraw Hill, Kogakusha 1976.

Articles:

6.1 to 6.27, 7.1 to 7.18, 7.26, 7.27, 8.1 to 8.5, 9.1 to 9.21, 9.24 to 9.29, 9.38 to 9.42

Reference Books:

1. T. M. Apostol, Mathematical Analysis, Narosa, New Delhi, 1985.
2. J. C. Burkill and H. Burkill, A second course in Mathematical Analysis, Cambridge University Press, 1970.
3. S. L. Lang, Analysis- I and II, Addison Wesley, 1969.

Semester – I

Course No: MAT- 403

Topology - I **Credits: 6**

Objective: To learn basics of general topology.

Unit - I Recall definitions of functions, images and inverse images of sets under given mappings, metric spaces, open disks in metric spaces, open and closed sets and their properties, continuity and its formulations in terms of open and closed sets.

Unit - II Introduction to topology and topological spaces, open sets, closed sets, closure, interior, neighborhoods, neighborhood systems, neighborhood bases at a point, weaker and stronger topologies, the Hausdorff Criterion, cluster point, derived set.

Unit - III Base for a topology, sub base for a topology, criterion for base, subspace of a topological spaces, nature of open sets, closed sets, Neighborhoods in subspaces, continuous functions on topological spaces and criterions of continuity, homeomorphism.

Unit - IV Product spaces, box topology on finite Cartesian product, Tychonoff topology or product topology on a general product, evaluation maps, quotient topology, quotient spaces, sequences in topological spaces and their inadequacy.

Unit V:Net, convergence of net, cluster point of a net, subnet, continuity of functions in terms of net, ultra net, Filters and their convergence, continuity of functions in terms of filters, ultra filter, relation between nets and filters.

Outcome: The students will be able to use the continuity of a function in abstract analysis.

Text Book: General Topology, Stephen Willard (Addison-Wesley Publishing Company, 1970.

Reference Book: Introduction to topology and modern analysis, G. F. Simmons (Tata McGraw-Hill Edition 2004)

Semester – I

Course No: MAT - 404

Complex Analysis – I **Credits: 6**

Objective: To get familiar with complex number system, functions of complex variables and their properties.

Unit – I The Complex number system: The field of complex numbers, The complex plane, Rectangular and polar representation of complex numbers; Intrinsic function on the complex field; The Complex plane.

Unit - II Metric spaces and Topology of C: Definition and examples of metric spaces; connectedness; sequence and completeness; compactness; continuity; Uniform convergence.

Unit - III Elementary properties and examples of Analytic functions:
Power series; The exponential function; Trigonometric and hyperbolic functions; Argument of nonzero complex number; Roots of unity; Branch of logarithm function. Analytic functions; Cauchy Riemann Equations; Harmonic function;

Unit - IV Analytic functions as a mapping; Mobius transformations; linear transformations; The point at infinity; Bilinear transformations, Complex Integration: power series representation of analytic functions; zeros of an analytic function.

Unit - V The index of a closed curve; Cauchy's theorem and integral formula; Gaursat's Theorem; Singularities: Classification of singularities; Residues; The argument principle.

Outcome: The student will become familiar with theory of complex functions.

Text Books:
1. John B. Conway; Functions of one complex variable, Narosa Publishing House, 2002.
2.J. V. Deshpande; Complex Analysis, Tata McGraw- Hill 1989.
Chapter-I:Articles: 2,3,4 from [1] & Articles 1.3 & 1.4 from [2].
Chapter–II: Articles: 1,2,3,4,5,6 from [1],
Chapter –VI: Articles:1,6.2,6.3,6.4,6.5,6.6from [2].
Chapter-VII: Articles:7.1,7.2,7.3 from [2].
Chapter- III: Article3 from [1]. Chapter–IV: Articles:2,3, 4 from [1].
Chapter –II: Articles: 2.1,2.2,2.3, from [2].
Chapter – IV: Articles 5 & 8 from [1], Chapter V: Articles1,2 & 3 from [1].

References:

1. Herb Silverman; Complex Variables, Haughton Mifflin Company Boston, 1975.
2. Ruel V. Churchill; Complex variables and applications, McGraw – Hill Publishing Company 1990.

Semester– I

Course No. MAT- 421

Differential Equations –I **Credits 6**

Objectives: To introduce the nonlinear 1st order ODE, method of approximate solutions, existence and uniqueness theorems. To introduce various systems of 1st order ODEs.

Unit - I Existence, uniqueness and Continuation of solutions: Introduction, Method of successive approximations for the initial value problem $y' = f(x,y)$, $y(x_0)=y_0$, The Lipschitz condition. Peano's existence theorem, maximal and minimal solutions.

Unit - II Continuation of solutions, Existence theorems for system of differential equations: Picard-Lindelof theorem, Peano's existence theorem, Dini's derivatives, differential inequalities.

Unit - III integral Inequalities: Gronwall- Reid-Bellman inequality and its generalization, Applications: Zieburs theorem, Peron's criterion, Kamke's uniqueness theorem.

Unit - IV Linear systems: Introduction, superposition principle, preliminaries and Basic results, Properties of linear homogeneous system, Theorems on existence of a fundamental system of solutions of first order linear homogeneous system, Abel-Liouville formula.

Unit - V Adjoin system, Periodic linear system, Floquet's theorem and its consequences, Applications, Inhomogeneous linear systems, applications.

Outcome: The student will able to solve the nonlinear 1st order ODE and various systems of 1st order ODEs.

Text Book:

1. E. A. Codington: An Introduction to Ordinary Differential Equations. Prentice-Hall international, Inc. Englewood Cliffs (1961). Chapter 6: Article 4&5.
2. Shair Ahmad and M. Rama Mohana Rao: Theory of Ordinary Differential Equations with Applications in Biology and Engineering, Affiliated East-West Press (1999)
Chapter – 1: Article 1.1 to 1.5
Chapter – 2: Article 2.1 to 2.3

References:

1. P. Hartman: Ordinary differential Equations, 2nd edition, SIAM, (2002.)
2. W. T. Reid: Ordinary Differential Equations, John Wiley, New York, (1971).
3. E. A. Codington and N. Levinson: Theory of Ordinary Differential Equations, McGraw-Hill, New York, (1955).

Semester – I

Course No: MAT - 422

ADVANCED DISCRETE MATHEMATICS–I **Credits 6**

Objective: The student will become familiar with discrete mathematics.

Unit - I Formal Logic: Statements, symbolic representation, tautologies. Semi groups and monoids: Definitions and examples of semi groups and Monoids.

Unit - II Homomorphism of semi groups and monoids, congruence relation and quotient semi groups, Sub semi groups and submonoids, direct products, basic homomorphism theorem.

Unit - III Lattices: Lattices as partially ordered sets, their properties, lattices as algebraic systems, sub lattices, direct products and homomorphism, some special lattices eg complete, complemented and distributive lattices.

Unit - IV Boolean algebras: Boolean algebras as lattices, various Boolean identities, the switching algebra example, sub algebra, direct product and homomorphism, join-irreducible elements

Unit - V Atoms and midterms, Boolean forms and their equivalence, midterm Boolean forms, (excluding free Boolean algebras), sum and products of canonical forms. Minimization of Boolean functions, applications of Boolean algebra to switching theory (using AND, ok and NOT gates), the Karnaugh Map method.

Text Book:

1. J. P. Tremblay and R. Manohar: Discrete Mathematical structures with Applications to Computer science, McGraw-Hill Book Co., 1997.

Chapter 1 (Sections 1.1 to 1.3), Chapter 3 (Sections 3.1 and 3.2), Chapter 4 (Sections 4.1 to 4.4)

Reference Book: C. L. Liu: Elements of discrete Mathematics, McGraw-Hill Book Co.

Semester – II

Course No: MAT – 411

Linear Algebra **Credit 6**

Objective: To learn techniques of linear algebra and its applications

Unit – I

Vector Spaces: Vector Spaces, subspaces, linear combinations and system of linear equation, linear dependence and independence, Bases and dimension maximal linearly independent subsets.

Unit – II

Linear Transformation and matrices: Linear Transformation, Null spaces, Ranges, the matrix representations of linear transformation, composition of linear transformation and matrix multiplication,

Unit – III Invertibility and isomorphisms, the change of coordinate matrix, dual spaces, Homogenous linear differential equation with constant coefficient.

Unit-IV Diagonalization : Eigen values and Eigen vectors, Diagonalizability, Invariant subspaces and the Caley-Hamilton theorem.

Unit –V

Inner product spaces: Inner product and norms, The Gram-Schmidt orthogonalization process and orthogonal complements, the adjoint of a linear operator, Bilinear and quadratic forms, Jordan Canonical form I, Jordan Canonical Form II.

Outcome:

After learning this course, the student will know linear algebra and its techniques and their applications.

Textbook:

Stephen S.H. Friedberg, Arnold J. Insel, Lawrence E. Spence: Linear Algebra, Prentice- Hall International, 4th edition.

Scope: **Chapter1**: Article 1.2 to 1.7, **Chapter 2:** Article 2.1 to 2.7, **Chapter 5**: 5.1, 5.2, 5.4 **Chapter 6**: 6.1 to 6.3, 6.8, **Chapter 7**: 7.1, 7.2

References:

1 I.N.Herstein: Topics In Algebra, Wiley Eastern Ltd., New Delhi 1975

2 D.S.Malik. J.N.Mordenson, and M.K.Sen: Fundamentals of Abstract Algebra. McGraw-Hill International Edition. 1997

3 S.Kumarsen:, Linear Algebra, A Geometric Approach, PHI. 2000

4 VivekSahai and VikasBist: Linear Algebra, Narosa Publishing House, 1999

5 V.Krishnamurthy et. Al., An Introduction to Linear Algebra, Affiliated East West Press, New Delhi, 2003

Semester II

Course No: MAT - 412

Real Analysis –II **Credits: 6**

Objective: The objective of this paper is to learn Measure theory, Lebesgue Integral and Mathematical inequalities

Unit - I Measure on the real line. Lebegue outer measure, measurable sets. Regularity. Measurable functions. Boral and Lebegue measurability. Examples.

Unit - III integration of functions of a Real variable. Integration of a simple function. Integration of non-negative functions. The general integral. Integration of series. Examples.

Unit - III Riemann and Lebeque Integrals, Differentiation. The four derivates, Functions of bounded variations. Lebegue's differentiation theorem, Examples.

Unit - IV Abstract Measure spaces. Measures and outer measures Extension of a measure. Uniqueness of the extension. Completion of a measure spaces. Integration with respective to a measure. Examples.

Unit - V The L^p spaces. Convex functions. Jensen's inequality. The inequalities of Holder and Minkowski Completeness of L^p ( ) Convergence in measure. Almost uniform convergence. Examples.

Outcome: The student will be able to apply the knowledge in advance research areas

Text Book:
G. de Barra, Measure Theory and Integration. Wiley Eastern Ltd. 1981. Reprint 2003.Articles: 2.1-2.5, 3:1 – 3.4, 4.1, 4.3 - 4.5, 5.1 – 5.6, 6.1 – 6.5, 7.1 and 7.2

Reference Books:

1. P. K. Jain and P. V. Gupta, Lebesgue Measure and Integration, New Age International (P) Ltd. Publication New Delhi. 1986 (Reprint 2000)
2. P. R. Halmos, Measure Theory, Von No strand, Princeton 1950
3. R. G. Bartle, The elements of Integration, John Wiley, New York 1966.
4. I. K Rana, An Introduction to measure and Integration, Narosa, Delhi 1997.

Semester II

Course No: MAT- 413

Topology -II **Credits 6**

Objective: To become familiar with various separation axioms, count ability axioms, compactness, connectedness in general topology.

Unit - I Separation axioms T_0, T_1, T_2, regularity and complete regularity, T_3 and Tychonoff spaces.

Unit - II Normality and its criterions, T_4-spaces, Urysohn's lemma, Countability axioms, first countability, second countability, Lindelof spaces, separable spaces

Unit - III Compactness and its characterizations, compactness together with Hausdorffness and regularity, locally compact spaces, compactification of topological spaces.

Unit - IV Refinement, star-refinement, barycentric refinement, locally finite collection, point-finite collection, paracompact spaces, metrication of topological spaces.

Unit - V Disconnected spaces, connected spaces, mutually separated sets and criterion of connectedness in terms of them, components, simple chain, Path wise connected spaces, arc wise connected spaces, locally connected spaces.

Outcome: The students will come to know how these concepts can be defined without metric concept.

Text Book:

General Topology, Stephen Willard (Addison-Wesley Publishing Company, 1970)

Reference Book:

Introduction to topology and modern analysis, G. F. Simmons (Tata McGraw-Hill Edition 2004)

Semester – II

Course No: MAT - 414

Complex Analysis - II **Credits: 6**

Objective: To become familiar with analytic functions and study their properties.

Unit - I Compactness and convergence in the space of Analytic functions:
Spaces of analytic functions; The weierstrass factorization theorem; factorization of the sine function; The gamma function; The Riemann zeta function.

Unit - II Harmonic functions: Basic properties of Harmonic functions and comparison with analytic function; Harmonic functions on a dick; Poisson integral formula; positive harmonic functions.

Unit - III Entire functions; Jensen's formula; The Poisson-Jenson formula; The genus and order of an entire function. Hadamard factorization Theorem.

Unit - IV Univalent functions; the class S; the class T; Bieberbach conjucture; sub class of s.
Unit - V Analytic continuation: Basic concepts; special functions.

Outcome: The student will become familiar with properties of analytic functions, harmonic functions, univalent functions and their properties.

Text Books:
1. John B. Conway; Functions of one complex variable, Narosa Publishing House, 1980.
2. Herb Silverman; Complex Variables Houghton Mifflin Company Boston 1975.
Chapter – VI: Articles 2,5,6,7 & 8 from [1]. Chapter – X: Articles 1& 2 from [1] Chapter- X: Articles 10.1, 10.2 & 10.3 from [2], Chapter- XI: Articles 1,2 & 3 from [1], Chapter XII: Articles 12.1& 12.2 from [2], Chapter – XIV: Articles 14.1 & 14.2 from [2]

Semester II

Course No: MAT - 431

Differential Equations - II **Credits: 6**

Objectives: To introduce general 2nd and higher order ODE, its transformations and the methods of solutions,

Unit - I Preliminaries, Basic Facts: Superposition principles, Lagrange Identity, Green's formula, variation of constants, Liouville substitution, Riccati equations Prefer Transformation. Higher order linear equations.

Unit - II Maximum Principles and their extensions, Generalized maximum principles, initial value problems, boundary value problems.

Unit - III Theorems of strum; sturm's first comparison theorem, sturm's separation theorem, strums second comparison theorem.

Unit - IV Sturm-Liouville boundary Value Problems: definition, eigenvalues, eigenfunctions, orthogonality.

Unit - V Number of zeros, Non oscillatory equations and principal solutions, Nonoscillation theorems.

Outcome: Student will able to solve the 2nd and higher order ODE and Sturm-Liouville boundary value problems and understand the qualitative properties of the differentialequations.

Text Books:1. Philip Hartman: Ordinary differential Equations, 2nd Edition SIAM, 2002.
Chapter – XI: Article 1 to 7. Chapter – 4 – article 8 only.
2. M. H. Protter and H. F. Weinberger, Springer: Maximum Principles in Differential Equations – Springer Verlag, New York, Inc, 1984.
Chapter 1. Articles 1 to 4.

Reference Books:

1. W. T. Reid: ordinary differential Equations, John Wiley N.Y. (1971).
2. E. A. Coddington and N. Levinson: Theory of Ordinary differential Equation, McGraw-Hill, New York, (1955).

Semester – II

Course No: MAT432

ADVANCED DISCRETE MATHEMATICS –II **Credits: 6**

Objective: To become familiar with some topics from discrete mathematics

Unit - I Definition of (undirected) graph, paths, circuits, cycles and subgraphs, degree of vertex connectivity, planar graphs and their properties.

Unit - II Trees, rulers formula for connected planar graphs. Complete graphs, Kuratowski's theorem (statement only) spanning trees, cut sets, fundamental cut-sets and cycles, minimal spanning trees and Kruskal's (statement only) algorithm, matrix representation of graphs,

Unit - III Euler's theorem on the existence of Eulerian paths and circuits, directed graphs, in degree and out degree of a vertex, weighted undirected graphs, strong connectivity, directed trees, search trees,

Unit - IV Introductory computability theory: Finite state machines and their transition table diagrams, equivalence of finite state machines, reduced machines, homomorphism, finite automata, acceptors, no-deterministic finite automata.

Unit - V Grammars and languages: Phase structure grammars, rewriting rules, derivations, sentential forms, language generated by a grammar, regular, contest free and contest sensitive grammars and languages.

Outcome: The student becomes familiar with graph theory, finite state machines and related areas.

Text Books:

1. J. P. Tremblay and R. Manohar: Discrete Mathematical structures with Applications to Computer science, McGraw-Hill Book Co., 1997.Sections 3.3, 4.6, and 5.1 to 5.6
2. C. L. Liu: Elements of discrete Mathematics, McGraw-Hill Book Co. Sections 6.5 and 7.1 to 7.7

Reference Books:

1. Seymour Lepschutz: Finite Mathematics, McGraw-Hill, New York.
2. S. Wiitala: Discrete Mathematics - A Unified Approach, McGraw-Hill.
3. J. E. Hhopcroft and J.D. Ullman: Introduction to Automata Theory, Languages and Computation, Narosa, New Delhi.

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